

Pro Arg Ala Ile Arg Thr Arg Tyr Leu Arg Thr Trp Phe Leu Val Asp  
165 170 175

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Leu | Ile | Ser | Ser | Ile | Pro | Val | Asp | Tyr | Ile | Phe | Leu | Val | Glu | Leu |     |
|     |     |     | 180 |     |     |     |     | 185 |     |     |     |     | 190 |     |     |
| Glu | Pro | Arg | Leu | Asp | Ala | Glu | Val | Tyr | Lys | Thr | Ala | Arg | Ala | Leu | Arg |
|     |     | 195 |     |     |     |     | 200 |     |     |     |     | 205 |     |     |     |
| Ile | Val | Arg | Phe | Thr | Lys | Ile | Leu | Ser | Leu | Leu | Arg | Leu | Leu | Arg | Leu |
|     | 210 |     |     |     |     | 215 |     |     |     |     | 220 |     |     |     |     |
| Ser | Arg | Leu | Ile | Arg | Tyr | Ile | His | Gln | Trp | Glu | Glu | Ile | Phe | His | Met |
| 225 |     |     |     |     | 230 |     |     |     |     | 235 |     |     |     |     | 240 |
| Thr | Tyr | Asp | Leu | Ala | Ser | Ala | Val | Val | Arg | Ile | Phe | Asn | Leu | Ile | Gly |
|     |     |     |     | 245 |     |     |     |     | 250 |     |     |     |     | 255 |     |
| Met | Met | Leu | Leu | Leu | Cys | His | Trp | Asp | Gly | Cys | Leu | Gln | Phe | Leu | Val |
|     |     | 260 |     |     |     |     |     | 265 |     |     |     | 270 |     |     |     |
| Pro | Met | Leu | Gln | Asp | Phe | Pro | Pro | Asp | Cys | Trp | Val | Ser | Ile | Asn | His |
|     |     | 275 |     |     |     |     | 280 |     |     |     |     | 285 |     |     |     |
| Met | Val | Asn | His | Ser | Trp | Gly | Arg | Gln | Tyr | Ser | His | Ala | Leu | Phe | Lys |
|     | 290 |     |     |     |     | 295 |     |     |     |     | 300 |     |     |     |     |
| Ala | Met | Ser | His | Met | Leu | Cys | Ile | Gly | Tyr | Gly | Gln | Gln | Ala | Pro | Val |
| 305 |     |     |     |     | 310 |     |     |     |     | 315 |     |     |     |     | 320 |
| Gly | Met | Pro | Asp | Val | Trp | Leu | Thr | Met | Leu | Ser | Met | Ile | Val | Gly | Ala |
|     |     |     |     | 325 |     |     |     |     | 330 |     |     |     |     | 335 |     |
| Thr | Cys | Tyr | Ala | Met | Phe | Ile | Gly | His | Ala | Thr | Ala | Leu | Ile | Gln | Ser |
|     |     |     | 340 |     |     |     |     | 345 |     |     |     |     | 350 |     |     |
| Leu | Asp | Ser | Ser | Arg | Arg | Gln | Tyr | Gln | Glu | Lys | Tyr | Lys | Gln | Val | Glu |
|     |     | 355 |     |     |     |     | 360 |     |     |     |     | 365 |     |     |     |
| Gln | Tyr | Met | Ser | Phe | His | Lys | Leu | Pro | Ala | Asp | Thr | Arg | Gln | Arg | Ile |
|     | 370 |     |     |     |     | 375 |     |     |     |     | 380 |     |     |     |     |
| His | Glu | Tyr | Tyr | Glu | His | Arg | Tyr | Gln | Gly | Lys | Met | Phe | Asp | Glu | Glu |
| 385 |     |     |     |     | 390 |     |     |     |     | 395 |     |     |     |     | 400 |
| Ser | Ile | Leu | Gly | Glu | Leu | Ser | Glu | Pro | Leu | Arg | Glu | Glu | Ile | Ile | Asn |
|     |     |     |     | 405 |     |     |     |     | 410 |     |     |     |     | 415 |     |
| Phe | Thr | Cys | Arg | Gly | Leu | Val | Ala | His | Met | Pro | Leu | Phe | Ala | His | Ala |
|     |     |     | 420 |     |     |     |     | 425 |     |     |     |     | 430 |     |     |
| Asp | Pro | Ser | Phe | Val | Thr | Ala | Val | Leu | Thr | Lys | Leu | Arg | Phe | Glu | Val |
|     |     | 435 |     |     |     |     | 440 |     |     |     |     | 445 |     |     |     |
| Phe | Gln | Pro | Gly | Asp | Leu | Val | Val | Arg | Glu | Gly | Ser | Val | Gly | Arg | Lys |
|     | 450 |     |     |     |     | 455 |     |     |     |     | 460 |     |     |     |     |
| Met | Tyr | Phe | Ile | Gln | His | Gly | Leu | Leu | Ser | Val | Leu | Ala | Arg | Gly | Ala |
| 465 |     |     |     |     | 470 |     |     |     |     | 475 |     |     |     |     | 480 |
| Arg | Asp | Thr | Arg | Leu | Thr | Asp | Gly | Ser | Tyr | Phe | Gly | Glu | Ile | Cys | Leu |
|     |     |     |     | 485 |     |     |     |     | 490 |     |     |     |     | 495 |     |

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<210> 2
<211> 2325
<212> DNA
<213> Homo sapiens
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<220>

<223> human hyperpolarization-activated voltage-gated  
cation channel 3 (HAC3)

<400> 2

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tcccttcggg tggtcggcag ccacaaagca gtggaaatcg agcaggagcg ggtgaagtca 240
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<210> 3

<211> 24

<212> DNA

<213> Artificial Sequence

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<223> Description of Artificial Sequence: amplification  
primer

<400> 3

cagccatgga ggcagagcag cggc



<223> Description of Artificial Sequence:degenerate  
amplification primer

<223> n = g, a, c or t

<223> n = g, a, c or t

27

<213> Artificial Sequence

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<213> Artificial Sequence

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<213> Artificial Sequence

27

<213> Artificial Sequence

25

25

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Lys Gly Ser Pro Asn Gly Glu Cys Gly Arg Gly Glu Pro Gln Cys Ser  
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Pro Ala Gly Pro Glu Gly Pro Ala Arg Gly Pro Lys Val Ser Phe Ser  
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 Cys Arg Gly Ala Ala Ser Gly Pro Ala Pro Gly Pro Gly Pro Ala Glu  
 115 120 125  
 Glu Ala Gly Ser Glu Glu Ala Gly Pro Ala Gly Glu Pro Arg Gly Ser  
 130 135 140  
 Gln Ala Ser Phe Met Gln Arg Gln Phe Gly Ala Leu Leu Gln Pro Gly  
 145 150 155 160  
 Val Asn Lys Phe Ser Leu Arg Met Phe Gly Ser Gln Lys Ala Val Glu  
 165 170 175  
 Arg Glu Gln Glu Arg Val Lys Ser Ala Gly Ala Trp Ile Ile His Pro  
 180 185 190  
 Tyr Ser Asp Phe Arg Phe Tyr Trp Asp Phe Thr Met Leu Leu Phe Met  
 195 200 205  
 Val Gly Asn Leu Ile Ile Ile Pro Val Gly Ile Thr Phe Phe Lys Asp  
 210 215 220  
 Glu Thr Thr Ala Pro Trp Ile Val Phe Asn Val Val Ser Asp Thr Phe  
 225 230 235 240  
 Phe Leu Met Asp Leu Val Leu Asn Phe Arg Thr Gly Ile Val Ile Glu  
 245 250 255  
 Asp Asn Thr Glu Ile Ile Leu Asp Pro Glu Lys Ile Lys Lys Lys Tyr  
 260 265 270  
 Leu Arg Thr Trp Phe Val Val Asp Phe Val Ser Ser Ile Pro Val Asp  
 275 280 285  
 Tyr Ile Phe Leu Ile Val Glu Lys Gly Ile Asp Ser Glu Val Tyr Lys  
 290 295 300  
 Thr Ala Arg Ala Leu Arg Ile Val Arg Phe Thr Lys Ile Leu Ser Leu  
 305 310 315 320  
 Leu Arg Leu Leu Arg Leu Ser Arg Leu Ile Arg Tyr Ile His Gln Trp  
 325 330 335  
 Glu Glu Ile Phe His Met Thr Tyr Asp Leu Ala Ser Ala Val Met Arg  
 340 345 350  
 Ile Cys Asn Leu Ile Ser Met Met Leu Leu Leu Cys His Trp Asp Phe  
 355 360 365  
 Cys Leu Gln Phe Leu Val Pro Met Leu Gln Asp Phe Pro Arg Asn Cys  
 370 375 380  
 Trp Val Ser Ile Asn Gly Met Val Asn His Ser Trp Ser Glu Leu Tyr  
 385 390 395 400  
 Ser Phe Ala Leu Phe Lys Ala Met Ser His Met Leu Cys Ile Gly Tyr  
 405 410 415

006699-01221



|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Gly | Arg | Gln | Ala | Pro | Glu | Ser | Met | Thr | Asp | Ile | Trp | Leu | Thr | Met | Leu |  |
|     |     |     | 420 |     |     |     |     | 425 |     |     |     |     |     |     | 430 |  |
| Ser | Met | Ile | Val | Gly | Ala | Thr | Cys | Tyr | Ala | Met | Phe | Ile | Gly | His | Ala |  |
|     |     | 435 |     |     |     |     | 440 |     |     |     |     | 445 |     |     |     |  |
| Thr | Ala | Leu | Ile | Gln | Ser | Leu | Asp | Ser | Ser | Arg | Arg | Gln | Tyr | Gln | Glu |  |
|     | 450 |     |     |     |     | 455 |     |     |     |     | 460 |     |     |     |     |  |
| Lys | Tyr | Lys | Gln | Val | Glu | Gln | Tyr | Met | Ser | Phe | His | Lys | Leu | Pro | Ala |  |
| 465 |     |     |     |     | 470 |     |     |     |     | 475 |     |     |     |     | 480 |  |
| Asp | Phe | Arg | Gln | Lys | Ile | His | Asp | Tyr | Tyr | Glu | His | Arg | Tyr | Gln | Gly |  |
|     |     |     | 485 |     |     |     |     | 490 |     |     |     |     |     | 495 |     |  |
| Lys | Met | Phe | Asp | Glu | Asp | Ser | Ile | Leu | Gly | Glu | Leu | Asn | Gly | Pro | Leu |  |
|     |     |     | 500 |     |     |     |     | 505 |     |     |     |     | 510 |     |     |  |
| Arg | Glu | Glu | Ile | Val | Asn | Phe | Asn | Cys | Arg | Lys | Leu | Val | Ala | Ser | Met |  |
|     |     | 515 |     |     |     |     | 520 |     |     |     |     | 525 |     |     |     |  |
| Pro | Leu | Phe | Ala | Asn | Ala | Asp | Pro | Asn | Phe | Val | Thr | Ala | Met | Leu | Thr |  |
|     | 530 |     |     |     |     | 535 |     |     |     |     | 540 |     |     |     |     |  |
| Lys | Leu | Lys | Phe | Glu | Val | Phe | Gln | Pro | Gly | Asp | Tyr | Ile | Ile | Arg | Glu |  |
| 545 |     |     |     |     | 550 |     |     |     |     | 555 |     |     |     |     | 560 |  |
| Gly | Thr | Ile | Gly | Lys | Lys | Met | Tyr | Phe | Ile | Glx | His | Gly | Val | Val | Ser |  |
|     |     |     | 565 |     |     |     |     |     | 570 |     |     |     |     | 575 |     |  |
| Val | Leu | Thr | Lys | Gly | Asn | Lys | Glu | Met | Lys | Leu | Ser | Asp | Gly | Ser | Tyr |  |
|     |     |     | 580 |     |     |     |     | 585 |     |     |     |     | 590 |     |     |  |
| Phe | Gly | Glu | Ile | Cys | Leu | Leu | Thr | Arg | Gly | Arg | Arg | Thr | Ala | Ser | Val |  |
|     |     | 595 |     |     |     |     | 600 |     |     |     |     | 605 |     |     |     |  |
| Arg | Ala | Asp | Thr | Tyr | Cys | Arg | Leu | Tyr | Ser | Leu | Ser | Val | Asp | Asn | Phe |  |
|     | 610 |     |     |     |     | 615 |     |     |     |     | 620 |     |     |     |     |  |
| Asn | Glu | Val | Leu | Glu | Glu | Tyr | Pro | Met | Met | Arg | Arg | Ala | Phe | Glu | Thr |  |
| 625 |     |     |     |     | 630 |     |     |     |     | 635 |     |     |     |     | 640 |  |
| Val | Ala | Ile | Asp | Arg | Leu | Asp | Arg | Ile | Gly | Lys | Lys | Asn | Ser | Ile | Leu |  |
|     |     |     | 645 |     |     |     |     |     | 650 |     |     |     |     | 655 |     |  |
| Leu | His | Lys | Val | Gln | His | Asp | Leu | Asn | Ser | Gly | Val | Phe | Asn | Asn | Gln |  |
|     |     | 660 |     |     |     |     |     | 665 |     |     |     |     | 670 |     |     |  |
| Glu | Asn | Ala | Ile | Ile | Gln | Glu | Ile | Val | Lys | Tyr | Asp | Arg | Glu | Met | Val |  |
|     | 675 |     |     |     |     |     | 680 |     |     |     |     | 685 |     |     |     |  |
| Gln | Gln | Ala | Glu | Leu | Gly | Gln | Arg | Val | Gly | Leu | Phe | Pro | Pro | Pro | Pro |  |
|     | 690 |     |     |     |     | 695 |     |     |     |     | 700 |     |     |     |     |  |
| Pro | Pro | Pro | Gln | Val | Thr | Ser | Ala | Ile | Ala | Thr | Leu | Gln | Gln | Ala | Ala |  |
| 705 |     |     |     |     | 710 |     |     |     |     | 715 |     |     |     |     | 720 |  |
| Ala | Met | Ser | Phe | Cys | Pro | Gln | Val | Ala | Arg | Pro | Leu | Val | Gly | Pro | Leu |  |
|     |     |     |     | 725 |     |     |     |     | 730 |     |     |     |     | 735 |     |  |

Ala Leu Gly Ser Pro Arg Leu Val Arg Arg Pro Pro Gly Pro Ala  
740 745 750

Pro Ala Ala Ala Ser Pro Gly Pro Pro Pro Pro Ala Ser Pro Pro Gly  
755 760 765

Ala Pro Ala Ser Pro Arg Ala Pro Arg Thr Ser Pro Tyr Gly Gly Leu  
770 775 780

Pro Ala Ala Pro Leu Ala Gly Pro Ala Leu Pro Ala Arg Arg Leu Ser  
785 790 795 800

Arg Ala Ser Arg Pro Leu Ser Ala Ser Gln Pro Ser Leu Pro His Gly  
805 810 815

Ala Pro Gly Pro Ala Ala Ser Thr Arg Pro Ala Ser Ser Ser Thr Pro  
820 825 830

Arg Leu Gly Pro Thr Pro Ala Ala Arg Ala Ala Ala Pro Ser Pro Asp  
835 840 845

Arg Arg Asp Ser Ala Ser Pro Gly Ala Ala Gly Gly Leu Asp Pro Gln  
850 855 860

Asp Ser Ala Arg Ser Arg Leu Ser Ser Asn Leu  
865 870 875

<210> 16  
<211> 749  
<212> PRT  
<213> Homo sapiens

<220>  
<223> human hyperpolarization-activated voltage-gated  
cation channel 2 (HAC2) missing amino terminus

<400> 16  
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Tyr Ser Asp Phe Arg Phe Tyr Trp Asp Leu Ile Met Leu Ile Met Met  
20 25 30  
Val Gly Asn Leu Val Ile Ile Pro Val Gly Ile Thr Phe Phe Thr Glu  
35 40 45  
Gln Thr Thr Thr Pro Trp Ile Ile Phe Asn Val Ala Ser Asp Thr Val  
50 55 60  
Phe Leu Leu Asp Leu Ile Met Asn Phe Arg Thr Gly Thr Val Asn Glu  
65 70 75 80  
Asp Ser Ser Glu Ile Ile Leu Asp Pro Lys Val Ile Lys Met Asn Tyr  
85 90 95  
Leu Lys Ser Trp Phe Val Val Asp Phe Ile Ser Ser Ile Pro Val Asp  
100 105 110  
Tyr Ile Phe Leu Ile Val Glu Lys Gly Met Asp Ser Glu Val Tyr Lys  
115 120 125

Thr Ala Arg Ala Leu Arg Ile Val Arg Phe Thr Lys Ile Leu Ser Leu  
 130 135 140  
 Leu Arg Leu Leu Arg Leu Ser Arg Leu Ile Arg Tyr Ile His Gln Trp  
 145 150 155 160  
 Glu Glu Ile Phe His Met Thr Tyr Asp Leu Ala Ser Ala Val Val Arg  
 165 170 175  
 Ile Phe Asn Leu Ile Gly Met Met Leu Leu Leu Cys His Trp Asp Phe  
 180 185 190  
 Cys Leu Gln Phe Leu Val Pro Leu Leu Gln Asp Phe Pro Pro Asp Cys  
 195 200 205  
 Trp Val Ser Leu Asn Glu Met Val Asn Asp Ser Trp Gly Lys Gln Tyr  
 210 215 220  
 Ser Tyr Ala Leu Phe Lys Ala Met Ser His Met Leu Cys Ile Gly Tyr  
 225 230 235 240  
 Gly Ala Gln Ala Pro Val Ser Met Ser Asp Leu Trp Ile Thr Met Leu  
 245 250 255  
 Ser Met Ile Val Gly Ala Thr Cys Tyr Ala Met Phe Val Gly His Ala  
 260 265 270  
 Thr Ala Leu Ile Gln Ser Leu Asp Ser Ser Arg Arg Gln Tyr Gln Glu  
 275 280 285  
 Lys Tyr Lys Gln Val Glu Gln Tyr Met Ser Phe His Lys Leu Pro Ala  
 290 295 300  
 Asp Met Arg Gln Lys Ile His Asp Tyr Tyr Glu His Arg Tyr Gln Gly  
 305 310 315 320  
 Lys Ile Phe Asp Glu Glu Asn Ile Leu Asn Glu Leu Asn Asp Pro Leu  
 325 330 335  
 Arg Glu Glu Ile Val Asn Phe Asn Cys Arg Lys Leu Val Ala Thr Met  
 340 345 350  
 Pro Leu Phe Ala Asn Ala Asp Pro Asn Phe Val Thr Ala Met Leu Ser  
 355 360 365  
 Lys Leu Arg Phe Glu Val Phe Gln Pro Gly Asp Tyr Ile Ile Arg Glu  
 370 375 380  
 Gly Ala Val Gly Lys Lys Met Tyr Phe Ile Glx His Gly Val Ala Gly  
 385 390 395 400  
 Val Ile Thr Lys Ser Ser Lys Glu Met Lys Leu Thr Asp Gly Ser Tyr  
 405 410 415  
 Phe Gly Glu Ile Cys Leu Leu Thr Lys Gly Arg Arg Thr Ala Ser Val  
 420 425 430  
 Arg Ala Asp Thr Tyr Cys Arg Leu Tyr Ser Leu Ser Val Asp Asn Phe  
 435 440 445

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|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Asn | Glu | Val | Leu | Glu | Glu | Tyr | Pro | Met | Met | Arg | Arg | Ala | Phe | Glu | Thr |
| 450 |     |     |     |     |     | 455 |     |     |     |     |     | 460 |     |     |     |
| Val | Ala | Ile | Asp | Arg | Leu | Asp | Arg | Ile | Gly | Lys | Lys | Asn | Ser | Ile | Leu |
| 465 |     |     |     |     | 470 |     |     |     |     | 475 |     |     |     |     | 480 |
| Leu | Gln | Lys | Phe | Gln | Lys | Asp | Leu | Asn | Thr | Gly | Val | Phe | Asn | Asn | Gln |
|     |     |     |     | 485 |     |     |     |     | 490 |     |     |     |     | 495 |     |
| Glu | Asn | Glu | Ile | Leu | Lys | Gln | Ile | Val | Lys | His | Asp | Arg | Glu | Met | Val |
|     |     |     | 500 |     |     |     |     | 505 |     |     |     |     | 510 |     |     |
| Gln | Ala | Ile | Ala | Pro | Ile | Asn | Tyr | Pro | Gln | Met | Thr | Thr | Leu | Asn | Ser |
|     |     | 515 |     |     |     |     | 520 |     |     |     |     | 525 |     |     |     |
| Thr | Ser | Ser | Thr | Thr | Thr | Pro | Thr | Ser | Arg | Met | Arg | Thr | Gln | Ser | Pro |
|     | 530 |     |     |     |     | 535 |     |     |     |     | 540 |     |     |     |     |
| Pro | Val | Tyr | Thr | Ala | Thr | Ser | Leu | Ser | His | Ser | Asn | Leu | His | Ser | Pro |
| 545 |     |     |     |     | 550 |     |     |     |     | 555 |     |     |     |     | 560 |
| Ser | Pro | Ser | Thr | Gln | Thr | Pro | Gln | Pro | Ser | Ala | Ile | Leu | Ser | Pro | Cys |
|     |     |     |     | 565 |     |     |     |     | 570 |     |     |     |     | 575 |     |
| Ser | Tyr | Thr | Thr | Ala | Val | Cys | Ser | Pro | Pro | Val | Gln | Ser | Pro | Leu | Ala |
|     |     |     | 580 |     |     |     |     | 585 |     |     |     |     | 590 |     |     |
| Ala | Arg | Thr | Phe | His | Tyr | Ala | Ser | Pro | Thr | Ala | Ser | Gln | Leu | Ser | Leu |
|     |     | 595 |     |     |     |     | 600 |     |     |     |     | 605 |     |     |     |
| Met | Gln | Gln | Gln | Pro | Gln | Gln | Gln | Val | Gln | Gln | Ser | Gln | Pro | Pro | Gln |
|     | 610 |     |     |     |     | 615 |     |     |     |     | 620 |     |     |     |     |
| Arg | Gln | Pro | Gln | Gln | Pro | Ser | Pro | Gln | Pro | Gln | Thr | Pro | Gly | Ser | Ser |
| 625 |     |     |     |     | 630 |     |     |     |     | 635 |     |     |     |     | 640 |
| Thr | Pro | Lys | Asn | Glu | Val | His | Lys | Ser | Thr | Gln | Ala | Leu | His | Asn | Thr |
|     |     |     |     | 645 |     |     |     |     | 650 |     |     |     |     | 655 |     |
| Asn | Leu | Thr | Arg | Glu | Val | Arg | Pro | Phe | Ser | Ala | Trp | Gln | Pro | Ser | Leu |
|     |     |     | 660 |     |     |     |     | 665 |     |     |     |     | 670 |     |     |
| Pro | His | Glu | Val | Ser | Thr | Leu | Ile | Ser | Arg | Pro | His | Pro | Thr | Val | Gly |
|     |     | 675 |     |     |     |     | 680 |     |     |     |     | 685 |     |     |     |
| Glu | Ser | Leu | Ala | Ser | Ile | Pro | Gln | Pro | Val | Thr | Ala | Val | Pro | Gly | Thr |
|     | 690 |     |     |     |     | 695 |     |     |     |     | 700 |     |     |     |     |
| Gly | Leu | Gln | Ala | Gly | Gly | Arg | Ser | Thr | Val | Pro | Gln | Arg | Val | Thr | Phe |
| 705 |     |     |     |     | 710 |     |     |     |     | 715 |     |     |     |     | 720 |
| Phe | Arg | Gln | Met | Ser | Ser | Gly | Ala | Ile | Pro | Pro | Asn | Arg | Gly | Val | Leu |
|     |     |     |     | 725 |     |     |     |     | 730 |     |     |     |     | 735 |     |
| Pro | Ala | Pro | Leu | Pro | Leu | Ile | Thr | Pro | His | Pro | Lys | Lys |     |     |     |
|     |     |     | 740 |     |     |     |     | 745 |     |     |     |     |     |     |     |